The Philippine Journal of Orthopaedics

CASE REPORT

Management of a Polytrauma Patient with L4 Bony Fracture-Dislocation, Multi-Level L1-L3 Flexion-Distraction (Bony Chance) Injuries, Lateral Compression III Pelvic Injury, and Lower Extremity Fractures: A Case Report

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ABSTRACT

This is the first documented case of a neurologically impaired polytrauma patient with multiple bony Chance injuries, a windswept pelvis, and lower extremity fractures.

The patient was a male miner in his mid-30s who incurred multiple injuries in his lower extremities and spine. He initially consulted at a secondary care facility but transferred hospitals for further management.

The index surgery was done four days post-injury (beyond 72 hours) and included open reduction, and stabilization of the affected spinal segments with pedicle screws/rods from the thoracolumbar spine to both sacroiliac joints. The patient was discharged after debridement for a surgical site infection of the spine, and definitive fixation of the right femur and left tibial plateau. At one year follow-up, the patient was ambulatory without assistance and with no complications.

In dealing with polytrauma patients with multiple spinal, pelvic, and lower extremity fractures, early treatment is recommended to prevent future complications.

Keywords. case report, polytrauma, Chance fracture, fracture-dislocation, flexion-distraction, spine

INTRODUCTION

Fracture-dislocations of the thoracolumbar spine are unstable injuries disrupting the three columns of the spine. These may be subdivided into flexion-rotation, shear, and flexion-distraction types. These must be immediately stabilized regardless of neurologic status.[1-3]

Flexion-distraction injuries, also known as Chance fractures or Chance variants, commonly occur with lap belt car restraints, and come with a high incidence of concomitant intraabdominal injuries. For isolated injuries with minimal angulation, brace treatment may be successful. Unstable injuries warrant surgical management, typically consisting of posterior pedicle screw instrumentation and fusion across the injured levels.[4] However, if this type of fixation is not possible, posterior pedicle screw instrumentation and fusion limited to two levels above and below the injury would be sufficient.[1,4]

Lateral Compression III fractures of the pelvis ("windswept pelvis") must be reduced and fixed. The recommendation is to apply a sacroiliac screw for unilateral injuries and transiliac screws for bilateral injuries.

ISSN 0118-3362 (Print)
eISSN 2012-3264 (Online)
Printed in the Philippines.

Received: September 20, 2024.
Accepted: November 18, 2024.
Published Online: January 7, 2025.
https://doi.org/10.69472/poai.2025.02

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Concurrent spinal fracture-dislocations and pelvic injuries rarely occur. For patients with such injuries and with signs of spinopelvic instability, spinopelvic fixation is needed.[5] We have found reports of non-contiguous lumbar fracture-dislocations,[6] but none involving multiple Chance fractures, a pelvic injury, and lower extremity fractures.

Principles of damage control orthopedics (DCO) are applied to polytrauma patients.[7] In addition to this, spinal injuries should be fixed as early as 24 hours from the time of injury. Complications are more likely when treatment is delayed later than 72 hours; these include prolonged mechanical ventilation and sepsis.[6]

CASE

Our patient was a male miner in his mid-30s who was working in a quarry and got trapped between a boulder and multiple construction aggregates. He suffered direct trauma to his face, chest, hip, and lower extremities. The patient was initially seen in a local hospital where fluid resuscitation, oxygen supplementation, nasal laceration suturing, and insertion of a closed tube thoracostomy (for pleural effusion) were done. The patient and his family opted to transfer to our institution three days post-injury due to financial constraints and the need for further specialized management.

Upon his arrival at our institution's emergency room, additional venous access was obtained for fluid resuscitation. He was then cleared by the general surgery service of any intraabdominal injuries via examination and Focused Assessment with Sonography in Trauma (FAST). The CTT was maintained.

Table 1. Pre-operative neurological examination

Sensory	Right	Left	Motor	Right	Left
C2-T12	2/2	2/2	C5-T1	5/5	5/5
L1-L2	2/2	2/2	L2	Deferred	Deferred
L3-L4	2/2	2/2	L3	Deferred	Deferred
L5	2/2	1/2	L4	Deferred	Deferred -
S2-S5	2/2	2/2	L5	3/5	0/5
			S1	5/5	0/5
Reflexes					
Biceps reflex (C5-C6)				++	++
Brachioradialis reflex (C5-C6)				++	++
Triceps reflex (C6-C7)				++	++
Patellar tendon reflex (L2-L4)				Deferred	Deferred
Medial hamstring reflex (L5-S1)				Deferred	Deferred
Ankle jerk reflex/ Achilles tendon (S1)				Deferred	Deferred

The Orthopaedic Trauma and Spine teams diagnosed the patient's injuries through physical examination, radiographs of the spine and extremities, and a spinal MRI. The spinal injuries included: an L4 burst fracture-dislocation, L1-L3 bony Chance injuries, and L1-L5 spinous process fractures. The patient also had a lateral compression Type III pelvic injury, an open right femoral shaft fracture, and a closed left tibial plateau fracture (Figures 1-5). A neurologic exam, limited by the existing injuries, yielded an ASIA score of C (Table 1).

At four days post-injury, open reduction, decompression, and stabilization were done on the lumbar spine and pelvis. The patient was positioned prone on a radiolucent table. After aseptic prepping and draping, a midline incision was used, curving to avoid skin abrasions (Figure 6).

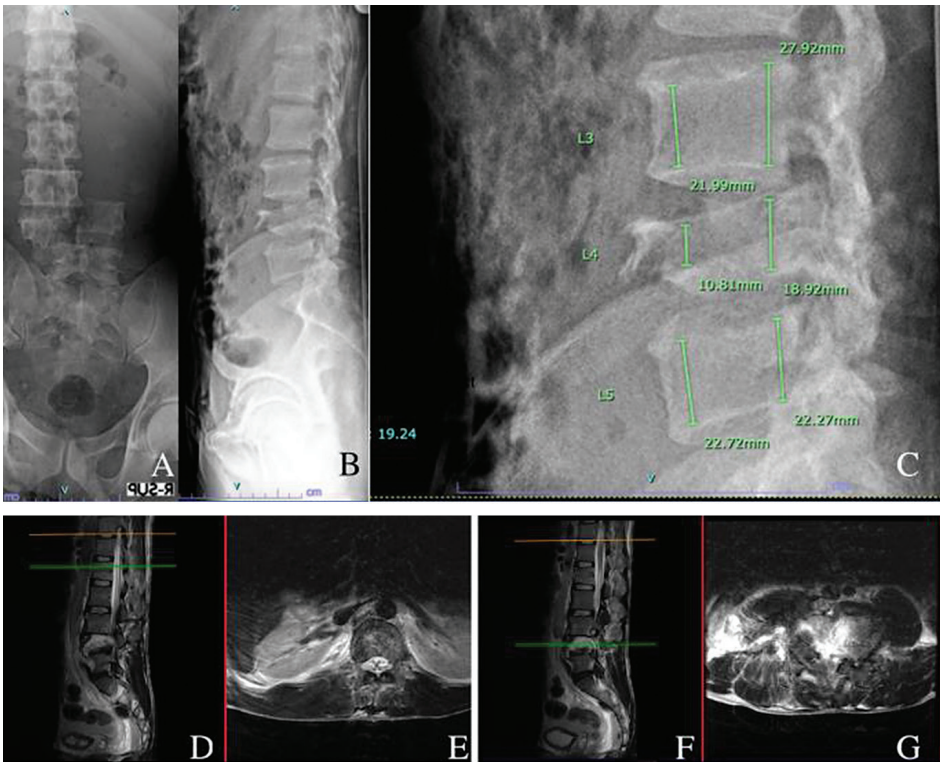

Figure 1. Initial anterio-posterior (AP) **(A)** and Lateral x-rays **(B)** show decreased vertebral body height on L4 and multiple spinous process fractures from L1-L5 **(C)**. Bony chance fractures/hyperintense fracture lines on L1-L3 were seen on the T2-weighted sagittal **(D)** and axial **(E)** cuts of the MRI. The fracture-dislocation was evident as a hyperintense lesion on the Sagittal cut **(F)** causing canal compromise and absence of spinal fluid on the axial cut of the MRI **(G)**.

Dissection was carried out subperiosteally. We found that the L4 vertebral body was translated laterally 3 cm from the midline. The posterior elements from L1-L5 were unstable, due to the injuries to the spinous processes (Figure 6). After exposure, pedicle screws were inserted on T11, T12, L1, L2, L3, L5, and bilateral iliac wings. Rods were inserted on both sides followed by sequential persuader and set screw application. A stable reduction was achieved (Figure 7). We copiously irrigated the wound and applied autograft before closing. The right femur was debrided, and external fixators were applied to the right femur, and the left lower extremity (knee-spanning) (Figure 8). The total operative time for this

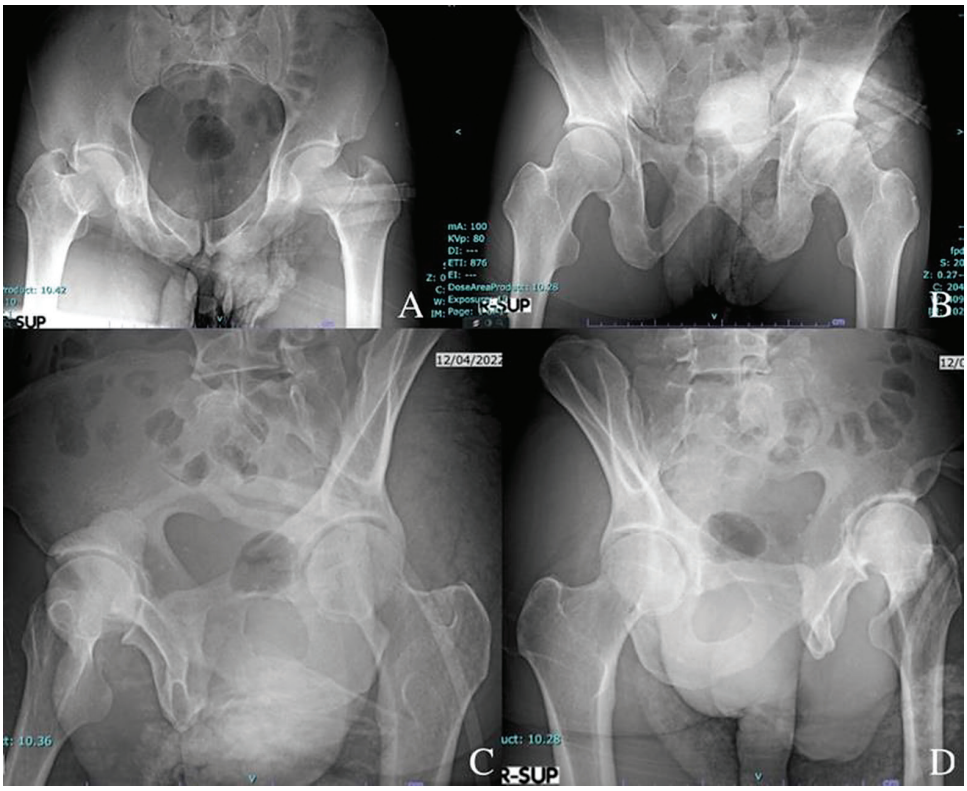

Figure 2. Pre-operative pelvic x-rays specifically the inlet **(A)**, outlet **(B)**, and Judet views **(C and D)** show no acetabular or femoral neck fractures. There was an iliac wing fracture on the right and a sacroiliac joint dissociation on the left.

Figure 3. Initial AP **(A)** and lateral **(B)** x-rays of the right femur show a comminuted fracture of the proximal third of the femoral shaft.

Figure 4. Initial AP **(A)** and lateral **(B)** x-rays of the Left leg show a comminuted tibial plateau fracture with intra-articular extension.

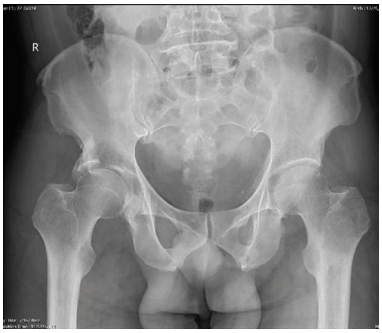

Figure 5. Initial left knee x-rays show the AP **(A)** and oblique views **(B-D)** of the tibial plateau fracture.

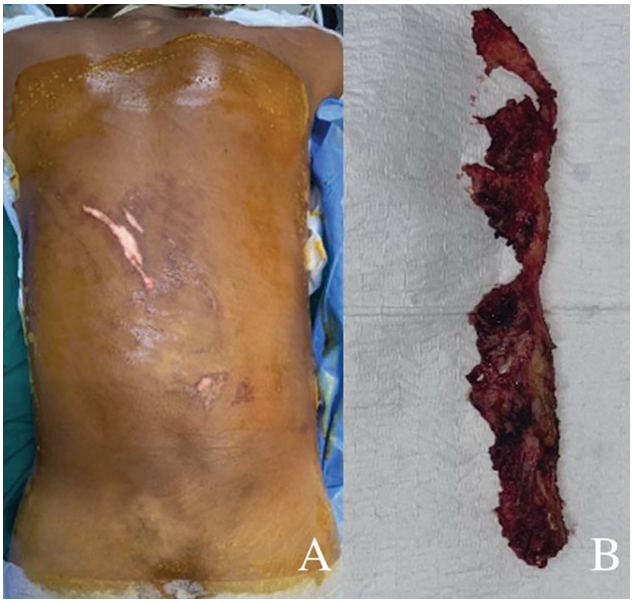

Figure 6. Intraoperative pictures showing the clinical appearance of the patient's thoracic and lumbar spine with abrasions **(A)** as well as the spinous process fractures which were immediately friable during dissection **(B)**.

procedure was six hours with a total blood loss of 1000 mL. Two bags of packed red blood cells were transfused intraoperatively with no transfusions post-operatively.

Two weeks postoperatively, the patient developed a surgical site infection of the spine that required debridement. The implants were maintained and a drain was inserted. The right femur was debrided a second time and fixed with a ring external fixator, and the left tibial plateau was reduced and fixed with plate and screws (Figures 9 and 10). Specimens were obtained from the spine and the pin tract sites of the right femur at the time of the second operation. Blood culture and sensitivity studies were also done in coordination with the infectious disease service. Both tissue and blood cultures revealed few colonies of *Pseudomonas aeruginosa* (Table 2). The drain was removed after five days once output was minimal (15 mL in 24 hours). Intravenous ciprofloxacin was given for two weeks. All operative sites were infection-free and CRP trends (Table 3) were decreasing. The patient was discharged on oral ciprofloxacin for one week.

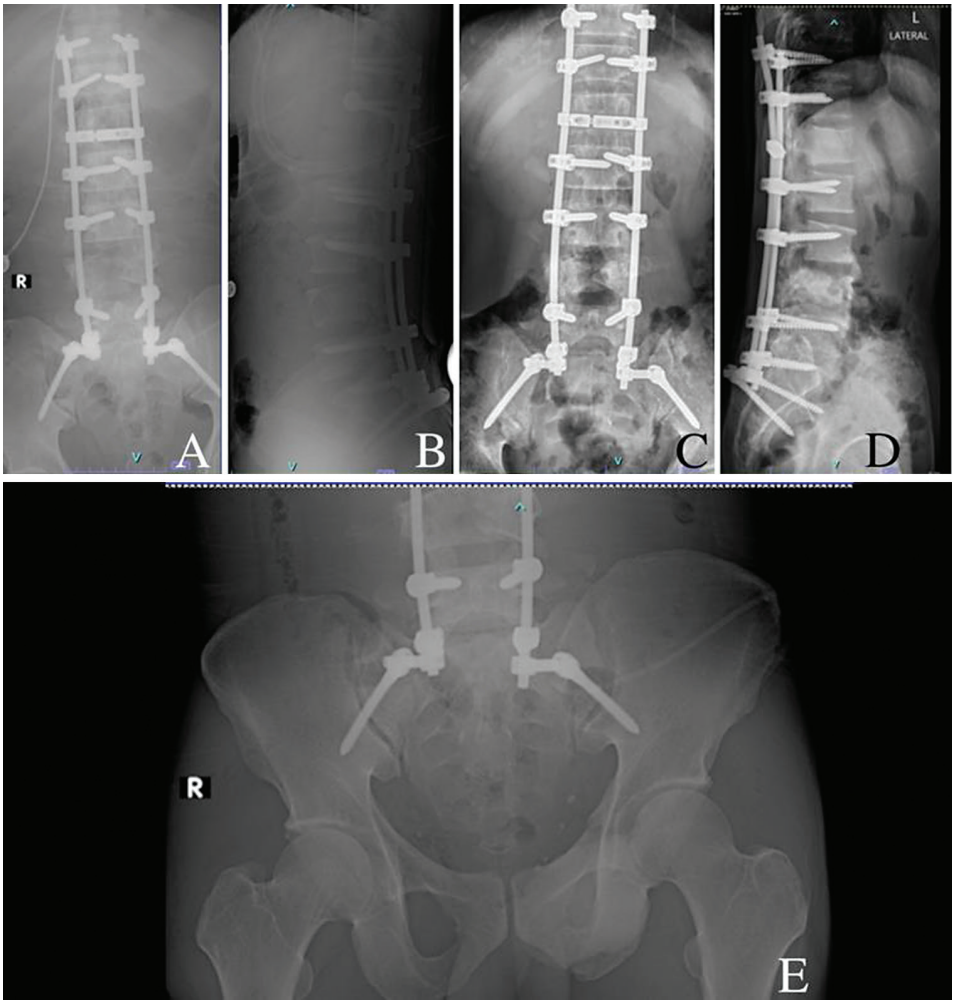

Figure 7. AP **(A)** and lateral **(B)** views of the lumbar spine immediately post-op and the AP **(C)** and lateral **(D)** views of the lumbar spine and pelvic x-ray after 6 months.

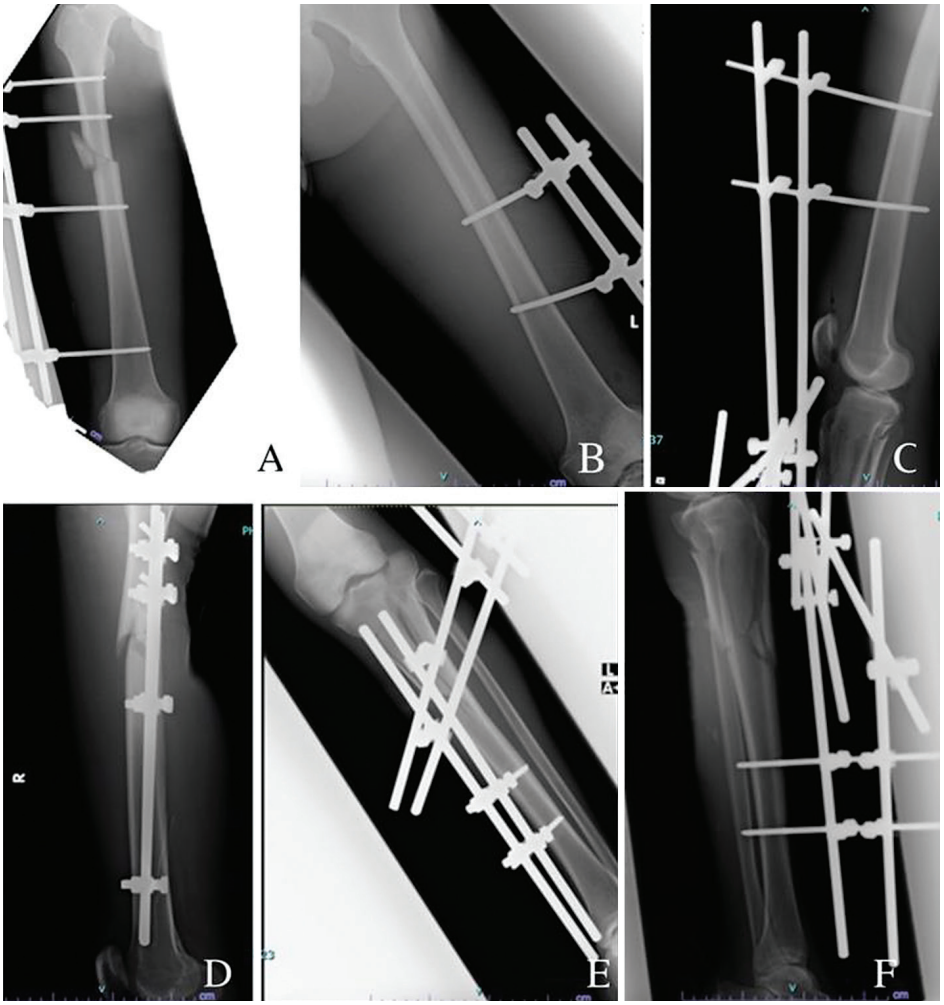

Figure 8. Postoperative (index surgery) x-rays of the patient's extremities. AP view of the right femur **(A)** and left femur **(B)**, lateral view of the left femur **(C)** and the right femur, AP **(E)** and lateral **(F)** views of the left tibia.

OUTCOME AND FOLLOW-UP

One month post-operatively, the patient's wounds were healed and the chest tube thoracostomy was removed. The patient was admitted to the Rehabilitation service ward for continued physical therapy. At two months post-operatively, he was able to do transfers (supine to sitting and sitting to standing) with assistance. At three months post-operatively, he was able to ambulate with assistance. Some neurologic deficits remained: manual muscle testing of 2/5 of great toe extension and plantarflexion (left), 4/5 of great toe extension (right), and sensation of 1/2 on the L5 dermatome (left).

At six months post-op, the patient was ambulatory without assistance. Despite improvement, certain deficits remained: manual muscle testing of 3/5 of great toe extension and plantarflexion (left), 4/5 of great toe extension (right), and sensation of 1/2 on the L5 dermatome (left). Also listed are the post-operative reflexes (Table 4 and 5). Wounds were well healed with no complications (Figure 11). At one year post-operatively, he was still ambulatory without assistance and underwent removal of ring external fixators (Figure 12). Left toe extension and plantarflexion (L5, S1) were weak on the left (Table 6). Repeat radiographs for the spine, pelvis, and lower extremities were also done showing no complications (Figures 13-15).

Table 2. Culture studies

Tissue gram stain (spine)	12-20 / OIF
Tissue gram stain (pin tract sites)	1-7/OIF
Tissue culture (spine and pin tract sites)	Few colonies of Pseudomonas Aeruginosa
Blood CS	Positive for Pseudomonas Aeruginosa after 16 hours of incubation

Table 3. C-reactive protein trends

Pre-operative (mg/L) (Reference Value: less than 6.00)	1 week post-op	2 weeks post-op	Debridement and Definitive Fixation	1 week post definitive fixation	2 weeks post definitive fixation	3 days after previous CRP	3 days after previous CRP	Upon discharge
180.54	116.93	142.87	110.91	78.16	48	24	12	6

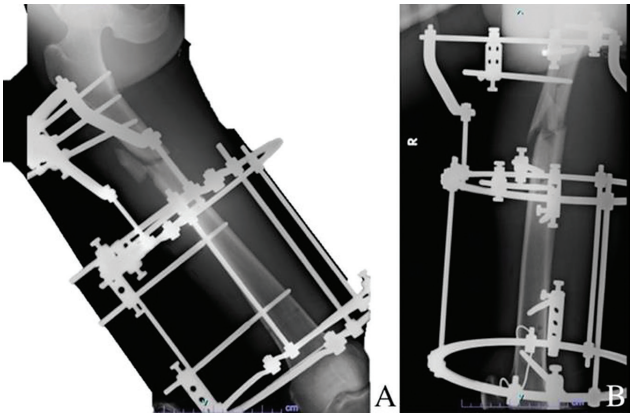

Figure 9. Conversion to ring external fixator via Ilizarov technique of the right femur. AP **(A)** and lateral views **(B)**.

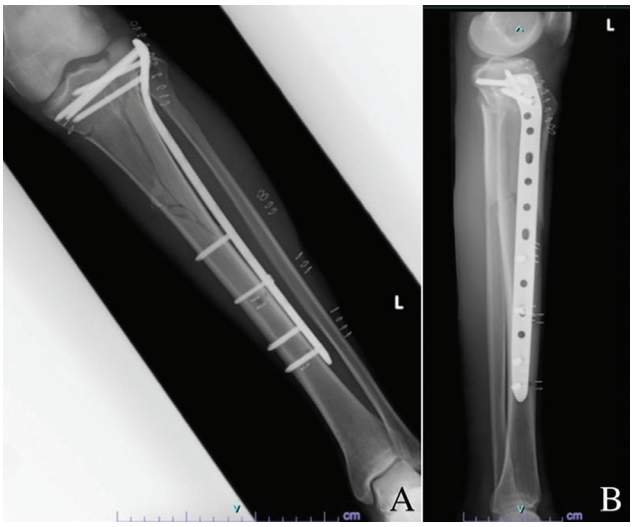

Figure 10. Postoperative x-rays following open reduction and internal fixation with a plate and screws of the left tibial plateau fracture, AP **(A)** and lateral **(B)** views.

Figure 11. The clinical picture of the operative site on the thoracolumbar area six months postoperatively shows no wound dehiscence or infection.

Table 4. Post-operative neurologic examination (3 months)

Sensory	Right	Left	Motor	Right	Left
C2-T12	2/2	2/2	C5-T1	5/5	5/5
L1-L2	2/2	2/2	L2	5/5	5/5
L3-L4	2/2	2/2	L3	5/5	5/5
L5	2/2	1/2	L4	5/5	5/5
S2-S5	2/2	2/2	L5	4/5	2/5
			S1	5/5	2/5
Reflexes					
Biceps Reflex (C5-C6)				++	++
Brachioradialis Reflex (C5-C6)				++	++
Triceps Reflex (C6-C7)				++	++
Patellar Tendon Reflex (L2-L4)				++	++
Medial Hamstring Reflex (L5-S1)				++	++
Ankle Jerk Reflex/ Achilles Tendon (S1)				++	++

Table 5. Post-operative neurologic examination (6 months)

Sensory	Right	Left	Motor	Right	Left
C2-T12	2/2	2/2	C5-T1	5/5	5/5
L1-L2	2/2	2/2	L2	5/5	5/5
L3-L4	2/2	2/2	L3	5/5	5/5
L5	2/2	1/2	L4	5/5	5/5
S2-S5	2/2	2/2	L5	4/5	3/5
			S1	5/5	3/5
Reflexes					
Biceps reflex (C5-C6)				++	++
Brachioradialis reflex (C5-C6)				++	++
Triceps reflex (C6-C7)				++	++
Patellar tendon reflex (L2-L4)				++	++
Medial hamstring reflex (L5-S1)				++	++
Ankle jerk reflex/ Achilles tendon (S1)				++	++

Table 6. One year post-operative neurologic examination (motor and reflexes)

Sensory	Right	Left	Motor	Right	Left
C2-T12	2/2	2/2	C5-T1	5/5	5/5
L1-L2	2/2	2/2	L2	5/5	5/5
L3-L4	2/2	2/2	L3	5/5	5/5
L5	2/2	1/2	L4	5/5	5/5
S2-S5	2/2	2/2	L5	5/5	4/5
			S1	5/5	4/5
Reflexes					
Biceps reflex (C5-C6)				++	++
Brachioradialis reflex (C5-C6)				++	++
Triceps reflex (C6-C7)				++	++
Patellar tendon reflex (L2-L4)				++	++
Medial hamstring reflex (L5-S1)				++	++
Ankle jerk reflex/ Achilles tendon (S1)				++	++

Figure 12. Clinical pictures of the patient at one year post-operatively, sagittal **(A)** and coronal **(B)** views. The patient was ambulatory with assistance.

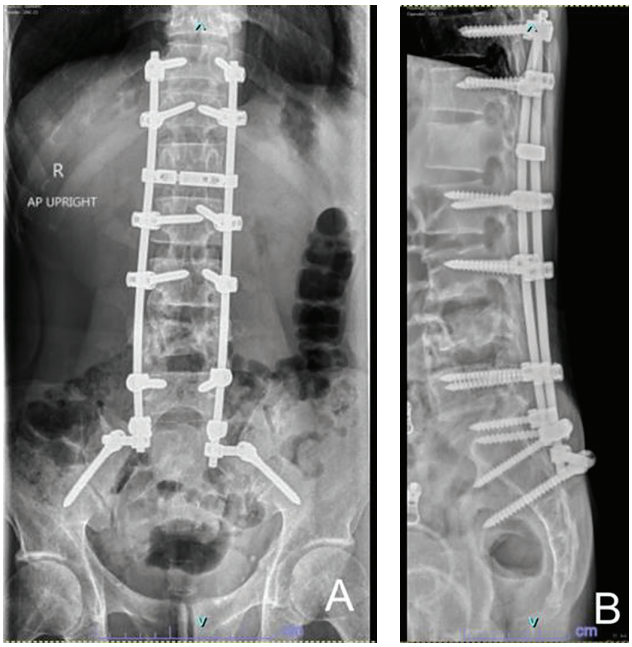

Figure 13. X-rays at 1 year postoperatively, spine AP **(A)** and lateral **(B)** views. No implant loosening or recurrence of dislocation. Bony fusion was seen at all levels with callus formation on the sacroiliac joints.

DISCUSSION

For multiply-injured patients, a multidisciplinary approach is warranted. This patient was treated in coordination among the orthopaedic trauma, orthopaedic spine, and trauma surgery services. Luckily, the patient did not need any thoracic or abdominal surgeries which may have delayed fixation of the spine and extremity injuries.

Given the neurologic deficits and the severity of the spinal injury, immediate surgery was needed. There are no reported contraindications in prone positioning for a polytrauma patient. Early spinal stabilization (within 24 hours if possible) improves outcomes in polytrauma,[7] shortening hospital stays and decreasing medical complications.[8]

Spinal procedures have a 2.8–20% infection rate, especially with instrumentation, increased surgical time, prolonged indwelling catheter use, and longer hospital stays.[6] These were factors we encountered in our patient that may have caused the surgical site infection.

Both fracture-dislocation and flexion distraction injuries warrant reduction, decompression, and stabilization with pedicle screws two levels above and below the injury.[9] With

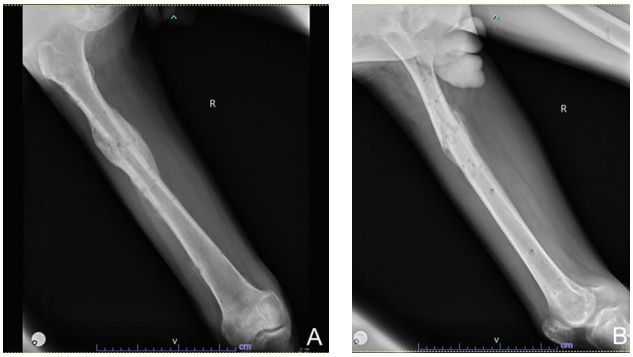

Figure 14. X-rays at one year postoperatively, femur AP **(A)** and lateral **(B)** views. Callus formation was seen on the femur with no signs of osteomyelitis.

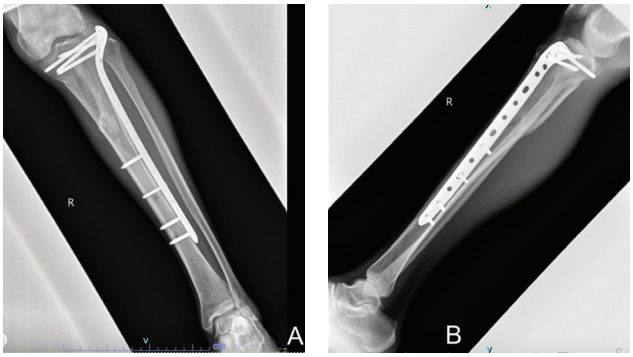

Figure 15. X-rays at one year postoperatively, leg AP **(A)** and lateral **(B)** views. Bony fusion was seen on the previous fracture with no implant loosening.

a concurrent pelvic injury, instrumentation was extended from the thoracolumbar spine to the pelvis via bilateral iliac screw insertions.[5]

Principles of damage control orthopedics (DCO) were applied for the lower extremity injuries, initially doing debridement and temporary external fixation, and later on shifting to definitive fixation.[7] A ring external fixator was chosen for the open femur fracture to allow immediate ambulation, and because pin tract infections precluded internal fixation.[10,11] The tibial plateau fracture was fixed with a plate and screws to achieve an anatomic reduction of the joint line and a stable fixation that allows immediate range of motion.[12]

CONCLUSION

Polytrauma patients must be diagnosed accurately and treated quickly, prioritizing life-threatening and unstable injuries. Multi-level and unstable spine injuries must be treated within 72 hours to prevent further complications such as surgical site infections and medical morbidities from prolonged immobilization.

ETHICAL CONSIDERATION

Patient consent was obtained before submission of the manuscript.

ACKNOWLEDGMENTS

The authors would like to express their gratitude to all members of the Department of Orthopaedics, the Spine Division, the Orthopaedic Trauma Division and the Ilizarov Service at the Philippine General Hospital. This includes both medical and non-medical staff, as well as the residents and fellows involved in the patient's care, specifically Drs. Rodolfo Garcia III, Tristan Dwight Sebastian, Francesco Antonio Valdecanas, Ralf Santamaria, and Pedro Juan Diego Tanchuling.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

FUNDING SOURCE

None.

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